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THE PRACTICALITY AND EFFECTIVENESS OF LESSON PLAN SET ON NATURAL SCIENCE SUBJECT IN TRAINING THE CRITICAL THINKING SKILLS OF JUNIOR HIGH SCHOOL STUDENTS

Maedy Ripani[i],
Aminuddin Prahatama Putra,
Dharmono
Lambung Mangkurat University,
Banjarmasin, Indonesia

Abstract:
This research aims to evaluate the practicality and effectiveness of natural science subject lesson plan set on the concept of plant structure and its utilization in technology in training the critical thinking skills of junior high school students. The lesson plan set includes syllabi, lesson plan, student worksheet, teaching material, media, and assessment sheet. The development is using Plomp and Nieveen's development steps which consist of preliminary research and prototyping. The method used in this research is descriptive qualitative. The research is done in five months (July-November 2017) at the State Junior High Schools 1 in Banjarmasin. The subject of the small group test is 12 students of VIII B Class and field test is 34 students of VIII D Class. The subject appointment is done purposively, which based on high, medium, and low academic capability. The practicality data is obtained from 1) lesson plan implementation and 2) students' responses. The effectiveness data is obtained from the learning result of 1) spiritual, 2) affective, 3) cognitive, 4) psychomotor, 5) critical thinking skills, 6) teachers' activities, and 7) students' activities. Data analysis is done descriptively. The result shows that the lesson plan set is practical to use based on the implementation of lesson plan and students' responses. Lesson plan set is effective to use based on the criteria of the learning result of 1) spiritual, 2) affective, 3) cognitive, 4) psychomotor, 5) critical thinking skills, 6) teachers' activities, and 7) students' activities.

Keywords: lesson plan set, development research, natural science, plant structure and its utilization in technology

1. Introduction

Indonesia national education aims to produce the graduates' qualification according to the graduate competence standard. The graduate competence in regulation of the

[i] Correspondence: email sitimardiah71@yahoo.com

Minister of Education and Culture of Indonesia includes attitudes, knowledge, and skills of the students which have to be reached on the elementary and middle education level. This becomes the foundation of education implementation.

Graduates' competency is obtained through learning activities. The learning process standard in the Regulation of the Minister of Education of Indonesia emphasize on several principles including finding out, scientific method, and process approach to strengthen scientific approach. The strengthening scientific approach is done by using disclosure-based learning including inquiry learning. For that reason, the lesson plan set has to match with the learning principles and models.

Lesson plan set consists of syllabi, lesson plan, teaching materials, student worksheet, and assessment sheet. In the development, lesson plan set can be adjusted to several aspects, including learning materials, school level, and learning model, for example, Science lesson plan set on the subject of Natural Science in junior high school (Aufiana *et al.,* 2015), and scientific approach based lesson plan set on the subject of Biology (Sumiadi *et al.,* 2015).

Natural Science subject is not only on mastering knowledge in form of facts, concepts, or principles, but also the process of the invention (Listyawati, 2012). Natural Science on the level of the junior high school consists of several materials; one of it is the Concept of Plant Structures and Its Utilization in Technology. Those concepts like Natural Science in common is best taught with lesson plan set focusing on invention, for example like Numbered Team in Guided Discovery (NTGD) based module (Purwanti *et al.,* 2015) and Discovery Model (Yusniawati *et al.,* 2015).

Inquiry model is a learning model that emphasizes on the students' activeness in finding and use the source of information and ideas to improve the understanding of certain topics or issues (Abidin, 2014). The students are not given the learning concepts directly, but they have to be active to find it by themselves. The learning concepts will be more meaningful. Inquiry can be done with teachers' guidance (guided inquiry) where teachers guide students in doing activities of giving first questions and directing the students to have discussions.

The inquiry is based on learning theories including constructivism theory by Piaget and Vigotsky, meaningful learning by David Ausubel, and invention learning by Jerome Bruner. Several theories emphasize on knowledge constructed by students through previous experiences and new information/knowledge obtained from activities. Knowledge according to Yamin (2012) is a construction by subjects in understanding something. Constructivism theory believes that the learning only happens when a learner connects new information and the existing one (Henson, 2015). Inquiry contributes better comparing to direct learning towards the students' learning result and other skills. It is proven by previous research (Dewi *et al*., 2013; Nugraha *et al.,* 2015; Saputra *et al*., 2016) which report that inquiry train critical thinking skills, scientific performance, and concept mastering.

Critical thinking is an active intellectual process in conception, implementing, analyzing, synthesizing, and/or evaluating information from observation, experiences, or reasoning, as consideration to take decisions (Devika & Soumya, 2016). Ennis (1985)

divides it into 5 groups with 12 indicators. These skills are needed in order to the students to think logically when taking a decision. The critical thinking skills are one of the skills which are aimed at learning in the Regulation of the Minister of Education and Culture of Indonesia.

Indonesia is ranked on 64 of 65 countries on natural science subject based on a survey by The Programme for International Student Assessment (PISA) in 2012 (OECD, 2014). Trends in International Mathematics and Science Study (TIMSS) reports that Indonesian students' ability in reasoning is ranked on 41 of 42 countries in 2011 (Wasis, 2015). It shows that the critical thinking skills of Indonesian students is low. Critical thinking skills is important to be trained to the students as early as possible. Several research prove that it can be trained through certain learnings, one of it is Problem Based Learning (PBL) (Afrizon *et al*., 2012) and inquiry (Nugraha *et al*., 2015).

The learning process needs to be supported by lesson plan set that fully supports inquiry model learning and facilitates and measure the critical thinking skills. Inquiry-based lesson plan set is expected to help the students in developing their critical thinking skills. So, it needs the research on the development of lesson plan set according to the criteria.

Lesson plan set development is a process to produce lesson plan set based on development model. Development research is an iterative research (McKenney & Reeves, 2014; Rawson & Hughes-Hassell, 2015) with the steps of planning, developing, and evaluating which aims to create learning/non-learning products (Richey & Klein, 2014). The development of lesson plan set consists of 3 steps: (1) preliminary research, (2) prototyping phase, and (3) assessment phase. Based on the explanation, a research question is raised: How is the practicality and effectiveness of the lesson plan set of natural science subject on the concept of plant structure and its utilization in technology based on guided inquiry model in training the critical thinking skills of junior high school students?

2. Material and Methods

This development research is using Plomp and Nieveen's (2013) development steps which consists of 3 phases: (1) preliminary research, (2) prototyping phase, and (3) assessment phase. However, this research is only focused on prototyping phase. This research is done at the state junior high school 1 in Banjarmasin in five months (July-November 2017).

Prototyping phase focused on formative evaluation according to Tessmer (1998) which consists of self-evaluation, expert review, one-to-one test, small group test, and field test. The subject of small group test is 12 students of VIII B Class, while field test is 34 students of VIII D Class. The subjects are appointed purposively, which is the students with a varied academic ability (high, medium, low). The practicality data is obtained from lesson plan implementation and students' responses towards the learning. The effectiveness data is obtained through the learning result of spiritual,

affective, cognitive, psychomotor, critical thinking skills, teachers' activities, and students' activities.

Data analysis to determine the practicality consists of 1) lesson plan implementation using score of 1-4 (1 = not implemented at all, 2 = partly small done, 3 = mostly done, 4 = all done) which later taken average and compared with Hart (1994)'s categories which is 3,50-4,00 = good, 3,00-3,49 = good enough, 2,00-2,99 = not really good and 1,00-1,99 = not good; and 2) students' responses are analyzed descriptively.

Data analysis to determine the effectiveness is the result of spiritual, affective, psychomotor, and critical thinking skills which is analyzed descriptively and measured using categories from Arikunto (2010), those are: very good (76%-100%), good (51%-75%), enough (26%-50%), and bad (≤ 26%). The result of cognitive learning will be based on the school's minimum criteria of mastery learning and analyzed descriptively. Teachers' activities will be analyzed descriptively using categories: ≤10 % low (good), >10 % high (bad), and students' activities will be analyzed descriptively using categories <10 % low (bad), ≥ 10 % high (good).

3. Results

3.1. Lesson Plan Set Practicality

The practicality is gained from 1) lesson plan implementation and 2) students' responses toward the learning.

3.1.1. Lesson plan implementation data

Lesson plan implementation data is showed on Table 1.

Table 1: Lesson plan implementation data

No	Activities	Score	Categories
1	Teachers do greeting and direct for praying	4	Good
2	Apperception, motivation, and delivering the learning goals	4	Good
3	Teachers instruct the students for pretest	3.83	Good
4	Teachers explain the learning steps, instruct the students to make groups, and distribute the students' worksheet	3.33	Good Enough
5	Teachers show the discourses (1. Orientation) and instruct the students to make research questions (2. Formulating the problems)	3.67	Good
6	Teachers guide the students to make hypothesis (3. Proposing hypothesis), do investigation (4. Data collecting) and analyze the data (5. Hypothesis testing)	4	Good
7	Teachers guide the students in making conclusion (6. Making Conclusion) and presentation.	3.67	Good
8	Teachers instruct the students to back to their seat and prepare to pray	3.67	Good

Information: 3,50-4,00 = good, 3,00-3,49 = good enough, 2,00-2,99 = not really good and 1,00-1,99 = not good

Based on table 1, the learning activities are good on all activities except number 4.

3.1.2. Students' responses toward the learning

Students' responses data toward the learning is presented on Table 2.

Table 2: Students' responses data towards the learning

No	Statements	Responses Percentage				
		SA	A	D	DA	SD
1	This natural science learning makes me have high willingness to follow the lessons	25.00	58.33	16.67	0.00	0.00
2	This natural science learning makes me have high willingness to use the learning time well	25.00	33.33	41.67	0.00	0.00
3	This natural science learning makes me easier to understand the lessons	41.67	50.00	0.00	8.33	0.00
4	This natural science learning is very interesting and not boring	58.33	25.00	16.67	0.00	0.00
5	This natural science learning makes me able to eliminate false concepts in myself	33.33	33.33	33.33	0.00	0.00
6	If natural science learning is done like this, I can remember the concepts from materials longer	8.33	58.33	33.33	0.00	0.00
7	This natural science learning can help me solving the real life problems linked with the learning topics	41.67	41.67	8.33	8.33	0.00
8	This natural science learning widen my knowledge	50.00	50.00	0.00	0.00	0.00
9	If natural science learning is done through inquiry model, it can improve learning achievements	8.33	66.67	16.67	8.33	0.00
10	If natural science learning is done like this, it can improve the group learning spirit	58.33	16.67	25.00	0.00	0.00
11	This natural science learning can improve my reasoning in learning the topic	25.00	66.67	8.33	0.00	0.00
12	This natural science learning can help me think more critical	41.67	41.67	16.67	0.00	0.00
13	This natural science learning can improve my creativity	58.33	41.67	0.00	0.00	0.00
14	This natural science learning can make me feel more appreciated in stating opinions	25.00	58.33	16.67	0.00	0.00
15	This natural science learning is making me brave in stating my opinions	25.00	58.33	16.67	0.00	0.00

Information: SA = Strongly Agree, A = Agree, D = Doubt, DA = Disagree, SD = Strongly Disagree

Table 2 shows the students' responses toward 15 questions which most of the student is agree and strongly agree. It shows that the learning implementation is gaining positive responses from the students.

3.2. Lesson Plan Set Effectiveness

The plan set effectiveness is determined from the learning result of 1) spiritual, 2) affective, 3) cognitive, 4) psychomotor, 5) critical thinking skills, 6) teachers' activities, and 7) students' activities.

3.2.1. Spiritual Learning Result

The data of students' spiritual learning result is shown on figure 1.

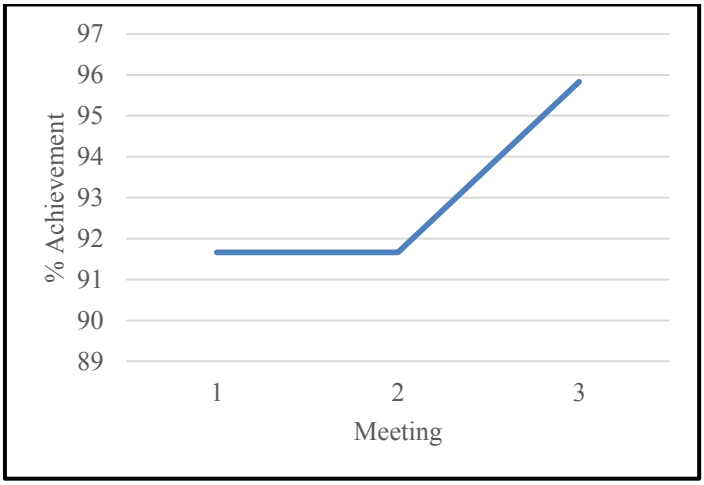

Figure 1: The diagram of average achievement of students' spiritual learning

Figure 1 shows the achievement of students' spiritual attitude is increasing.

3.2.2. Affective Learning Result

The data of affective learning result is shown on figure 2.

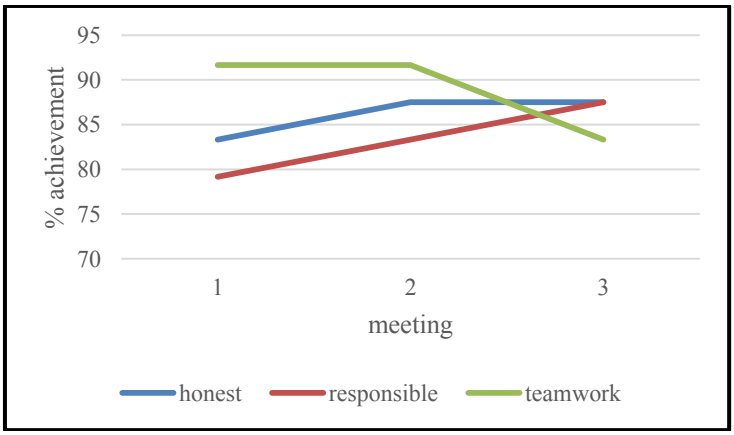

Figure 2: The diagram of students' affective achievement average

Based on figure 2, the achievement of honest and responsible attitude is increasing, but teamwork tends to decrease.

3.2.3. Cognitive Learning Result

The data of cognitive learning result can be seen on Table 3.

Table 3: The summary of students' cognitive learning result

Data source	Maximum score	Learning result		Total	% passed (classical completeness)
		Pass (person)	Not passed (person)		
Pre test	100	0	34	34	0
Post test	100	26	8	34	76,47

Information: school's minimum criteria of mastery learning = 85

Table 3 shows that the result of cognitive learning on pre-test is not passing, but on the post-test it already passed the minimum classical completeness of 75%.

3.2.4. Psychomotor Learning Result

The data of psychomotor learning result is shown on figure 3.

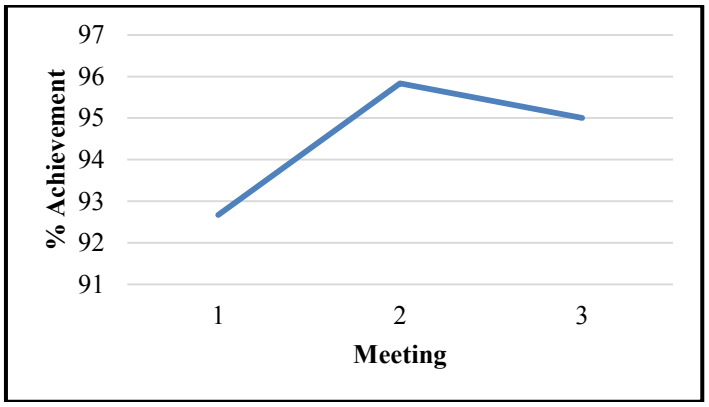

Figure 3: The summary of students' psychomotor learning result

Figure 3 shows the result of psychomotor learning is increasing on second meeting but tend to decrease on the third meeting.

3.2.5. The Result of Critical Thinking Skills Learning

The data of critical thinking skills learning result is shown on figure 4.

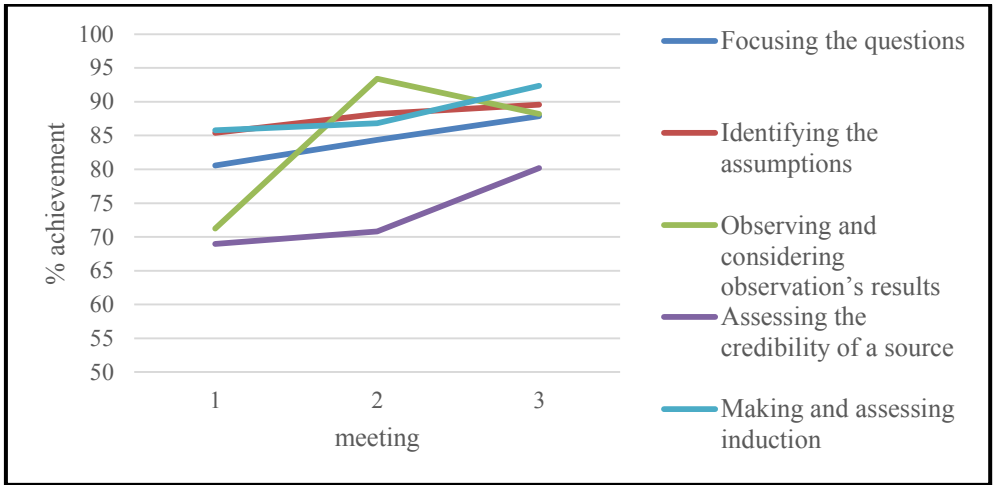

Figure 4: Data of students' critical thinking skills

According to figure 4, it can be derived that the students' critical thinking skills is increasing on the indicators of focusing the questions, identifying the assumptions, assessing the credibility of a source, and making and assessing induction. However, the indicator of observing and considering observation's result tends to decrease.

3.2.6. Teachers' activities

The data of teachers' activities is shown on table 4.

Table 4: Teachers' activities data

No	Teachers' Activities	f	%	Categories
1	Giving apperception, motivation, and delivering learning goals	3.67	9.09	Good
2	Presenting the course according to materials and guiding the students in making the questions and the research questions.	3.67	9.09	Good
3	Guiding the students in making the relevant hypothesis to the problems	3.00	7.44	Good
4	Guiding the students in doing investigation	8.33	20.66	Bad
5	Guiding the students in collecting data from investigation	6.67	16.53	Bad
6	Guiding the students to analyze the data	9.00	22.32	Bad
7	Giving chances to each groups/particular groups to present the investigation result	3.33	8.27	Good
8	Guiding the students to make the conclusion	2.67	6.61	Good

Information: ≤ 10 (good), > 10 (bad)

Based on table 4, it can be known that most of teachers' activities is already good, including activity 1, 2, 3, 7, and 8. However, activity 4, 5, and 6 is felt not good.

3.2.7. Students' Activities

The data of students'' activities is shown on table 5.

Table 5: Students' Activities Data

No	Students' Activities	f	%	Categories
1	Responding teachers' apperception and motivation	2.50	13.76	Good
2	Raising the questions and its research questions	1.89	10.40	Good
3	Creating hypothesis	1.33	7.34	Bad
4	Creating investigation procedures and doing investigation	3.06	16.82	Good
5	Noting the result of investigation	2.72	14.98	Good
6	Analyzing the data	4.00	22.01	Good
7	Presenting the investigation's results	1.33	7.34	Bad
8	Creating conclusions	1.33	7.34	Bad

Information: <10 (bad), ≥10 (good)

Table 5 shows that majority of the students' activities is already good (1, 2, 4, 5 and 6). However, the activity 3, 7, and 8 is bad.

Based on the result, it can be inferred as follows:

a) Lesson plan set is practical because 1) lesson plan can be implemented well and 2) students respond positively to learning.
b) Lesson plan set is effective because 1) students' spiritual learning result is very good, 2) students' affective learning result is very good, 3) students' cognitive learning result is surpassing the minimum classical completeness, 4) students' psychomotor learning result is very good, 5) students' critical thinking skills

learning result is very good, 6) most teachers' activities are good, and 7) most students' activities are good.

4. Discussion

4.1. Lesson Plan Set Practicality

Lesson plan set practicality is gained from lesson plan implementation data and students' responses. Lesson plan implementation is already good. This means that the learning process is in line with the plan. The process of learning and students' individual development is influenced by teachers' ability to plan the learning process (Gedviliene, 2012). Practical means that the lesson plan is ready to use by teachers and students (Khomsiatun & Retnawati, 2012) This is supported by previous research (Saputra *et al*., 2016; Nugraha *et al.,* 2015; Sumarauw *et al*., 2017) which concluded that the learning implementation with inquiry-based lesson plan set is categorized as good.

The learning process received positive responses from the students towards the learning situation which make the students feel interested to follow the lesson using guided inquiry mode (Sari *et al*., 2016). Sumarauw *et al*., (2017) stated that learning which is done in several ways of learning which are previously implemented motivate those students to be more enthusiastic in the process.

The students' positive responses towards the learning are linked with the opportunities to the students in expressing their opinion and experiments. The students feel more appreciated in stating opinions. The research of Rahmawati *et al.*, (2016) shows that the students are happy and give positive responses toward the learning using guided inquiry model because the students can directly apply what they learn and make them braver to state their opinions.

4.2. Lesson Plan Set Effectiveness

The effectiveness of lesson plan set is analyzed from the learning result of spiritual, affective, cognitive, psychomotor, critical thinking skills, teachers' activities, and students' activities. Overall, the lesson plan is considered effective.

Students' spiritual attitude is increasing and categorized as very good. It is influenced by several factors, including teachers' interaction with the students like how teachers give models, motivations, warnings, directions, and supports (Ariantini *et al*., 2014) and school's environment (Mahardika *et al*., 2016). Spiritual intelligence and learning motivation are linked with students' learning achievement (Haryani & Darminto, 2015). This is in line with other research (Jannah *et al*., 2016; Yunita, 2016; Diawati *et al*., 2016) which reports that inquiry has the positive impact towards students' spiritual.

Students' affective is categorized as very good. The achievement of honest and responsible attitude is increasing, but teamwork tends to decrease. This achievement is linked to teachers' guidance during the learning process. According to Jaya *et al.,* (2014), this is trained in the step of first idea test. The solving of the research question in inquiry model becomes training for the students to improve their communication and

teamwork quality (Widoretno *et al.,* 2015). This is important because knowledge is also constructed through social interaction (Churcher *et al.,* 2014; Ultanir, 2012; and Kiraly, 2014) which is supported by existing research (Jannah *et al.,* 2016; Yunita, 2016; Koksal & Berberoglu, 2014) which found out that inquiry has positive impact toward students' affective.

The students' cognitive learning result with the lesson plan is effective. The post-test result is fulfilling the minimum classical criteria which are 75%. The inquiry made a more effective learning comparing to conventional learning (Ambarsari *et al*., 2013) because it facilitates three processes of learning according to invention learning theory (Bruner, 2009). Students are pushed to be active to construct their own knowledge.

Inquiry improves students' involvement and produces a meaningful learning (Berry & Berry, 2014; Blessinger & John, 2015). The inquiry also attempts to connect the students with their own knowledge. Ausubel stated that learning becomes meaningful if only learning is mutually connected with own life experience (Huang and Chiu, 2015). Inquiry positive role towards the students' cognitive is proven by previous research (Diawati *et al.,* 2016; Dewi *et* al., 2013; Jannah *et al*., 2016).

Students' psychomotor is decreasing on the third meeting because increasing difficulty comparing to the previous meeting. However, their overall psychomotor learning result is categorized as very good. It is because of the use of guided inquiry learning. Teachers in guided inquiry learning give much guidance which later reduces its frequency according to the scaffolding by Vygotsky's social development theory (Diawati *et al.,* 2016). Various research results also support this finding (Jannah *et al*., 2016; Yunita, 2016; Zaini, 2016).

Critical thinking becomes one of the lesson plan set effectiveness (Zaini & Supiati, 2017). Critical thinking skills of the students already fulfills good category on each indicator. It improves on the indicator of focusing questions, identifying problems, assessing the credibility of a source, and creating and assessing induction. However, the indicator of observation and considering observation results tend to decrease.

The ability to focus on the questions and identifying assumptions increase through practicum based activities (Liandari *et al*., 2017). Students' ability to observe and determine its result decreased on the third meeting because it had higher difficulties comparing to previous meetings. Induction ability (creating conclusion) involving analytical and evaluation based on supporting consideration and reasoning (NC State University, 2014). Positive contributions of guided inquiry towards critical thinking skills is supported by previous researches (Duran & Dokme, 2016; Yunita, 2016; Zaini & Asnida, 2016; Zaini *et al*., 2017; Zaini & Rusmini *et al*., 2016).

Teacher activities are better on the activities of giving apperception, motivation, delivering learning goals, guiding the students to make questions and research questions, guiding the students to create relevant hypothesis toward the problems, giving opportunities to the students for presenting the result of the investigation, and guiding the students to create conclusions. Low teachers' activities aimed to make the learning are central on the students. Teachers acted as the facilitator who guided the students to learn (Sumarauw *et al*., 2017).

Teachers' dominant activities are guiding the students in doing the investigation, collecting the data, and analyzing the data. The investigation still needs teachers' guidance particularly at the third meeting because it had more difficulty and danger.

Teachers reduced the guidance little by little, so the students were trained independently with inquiry (Jannah, *et al*., 2016). Inquiry can reduce teachers' dominant in learning which is supported by previous researches (Yunita, 2016).

Students' activities are categorized as good including responding to apperception and motivation, proposing questions and its research questions, creating working procedures and doing investigation, noting the investigation result, and analyzing the data. Students' activities which are low frequency are creating hypothesis, presenting the student worksheet's answers, and creating conclusion. Sumarauw *et al*., (2017) reported that the students are active in doing investigation, collecting, and analyzing data on the guided inquiry. One of the problems in implementing inquiry is the long time needed. Inquiry has positive impact towards the students' activities which is supported by previous researches (Sari *et al*., 2016; Berry & Berry, 2014; Zaini & Rusmini *et al*., 2016).

5. Conclusion

The conclusion of this research is as follows:

a) Lesson plan set is practical based on 1) Lesson plan implementation and 2) students' responses.
b) Lesson plan set is effective based on 1) spiritual, 2) affective, 3) cognitive, 4) psychomotor, 5) critical thinking skills, 6) teachers' activities, and 7) students' activities.

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